Cue Utilization and Encoding Specificity in Picture Recognition by Older Adults

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Abstract:
According to the encoding specificity principle, memory is best when encoding and retrieval conditions are compatible. Some researchers have suggested that older adults encode information in a general fashion and are less sensitive to the specific contextual aspects of a memory situation due to limited processing resources. We investigated the hypothesis that age interacts with encoding specificity. Young and old adults studied target pictures in the presence or absence of pictorial cues factorially varied at encoding and retrieval. If the older adults used the specific cuing information differently from the younger adults, age should have interacted with the encoding and retrieval variables. The results provided no evidence for such an interaction and indicated that both ages showed evidence of encoding specificity. To investigate the role of processing resources in encoding specificity, old and young adults also studied the pictures while simultaneously performing a digit-monitoring task. The divided-attention manipulation also did not interact with age, as both young and old adults showed encoding specificity effects of comparable magnitude in both control and divided-attention conditions.

Article:
Craik and Simon (1980) have argued that older adults encode information at a more general level than young adults. Their study suggests that the encoding specificity principle, that memory is best when encoding and retrieval conditions are compatible (Tulving & Thomson, 1973), interacts with age due to difficulties older adults have in encoding specific contextual information. Rabinowitz et al. (1982) found evidence for an age × encoding specificity interaction using strong and weak retrieval cues in a verbal recall paradigm. However, Park et al. (1984) factorially varied the presence or absence of pictorial detail in a picture-recognition task. They found strong evidence for encoding specificity in both old and young adults with contextual information that differed from the Rabinowitz et al. paradigm in that it was highly integrated both visually and semantically with the target. The present study is an examination of encoding specificity effects in a picture-recognition task when there is no physical or semantic relationship between the target and the contextual cue. Support for the Craik and Simon (1980) hypothesis exists if the young adults' performance is facilitated more by the presence of specific contextual cues compared to the old adults, whereas it would not be supported if compatible cues at encoding and retrieval facilitate old adults equally.

A second issue of interest in the present study was the effects of a divided-attention task on the use of contextual information, as well as on picture recognition itself. Rabinowitz et al. (1982) argued that the basis for age-related differences in encoding in older adults is a limited processing capacity, However, Park et al. (1986) found no evidence that picture recognition was more disrupted by a divided-attention task in older adults than in young adults. If the Rabinowitz et al. argument is correct, a divided-attention task applied to both age groups should leave less remaining capacity for the secondary memory task in aging persons. This should result in a greater performance decrement in old adults compared to the younger adults, even if performance without divided-attention were equal. Furthermore, the processing resources argument would predict that older adults should show less sensitivity to specific contextual information under conditions of divided attention if general encoding of contextual information occurs as a result of limited resources, as hypothesized by Rabinowitz et al. For these reasons, as well as to determine if the finding in the Park et al. study was replicable with a different set of pictorial stimuli, the divided-attention manipulation was included in the present study.

METHODS

Subjects. — There were 51 research participants in this study. Of these, 27 were undergraduate college students (M age = 20.4 years), and 24 were healthy, community-dwelling older adults (M age = 68.96 years). All participants completed the OARS Multidimensional Functional Assessment Questionnaire (Duke University, 1975) and the 30-Point Word Familiarity Survey, a measure of verbal intelligence (Gardner & Monge, 1977). Health measures did not differ significantly, but vocabulary scores did, with means of 12.59 and 19.29 for young and old respectively, a significant difference, t (49 = 4.83, $p < .01$).

Stimulus materials. —The stimuli were constructed from the Snodgrass and Vanderwart (1980) pool of pictures. A total of 64 pictures were selected to serve as target items. An additional 64 pictures that were unrelated to the targets were selected to serve as cues for the target pictures. Unrelated targets and cues were mounted side by side with the target located on the left and right sides equally often. Participants could readily discriminate the target from the cue, as the target was drawn with thick black lines whereas the cue was drawn with thinner, lighter dark grey lines. The total stimulus set also included 32 distractors consisting of pictures not used as targets or cues in the acquisition set. There were 16 distractors that consisted only of a single target item outlined in thick black ink and 16 distractors that included a target with a cue.

Design. — There were four between-groups conditions created by crossing age (young or old) with attentional condition (regular or divided). In addition, the presence or absence of cues at encoding and retrieval was factorially varied within participants so that, of the 64 acquisition items that each participant received, 16 had a cue present at both encoding and retrieval (present-present condition), 16 had a cue present at encoding but no cue present at recognition (present-absent), 16 had no cue present at encoding but a cue present at recognition (absent-present), and the remaining 16 had no cue present at either encoding or retrieval (absent-absent).

Procedure. — Research participants were instructed to study the target item; they were told that sometimes an additional picture would be present and that they could use it to help them remember the item, but that their memory would be tested for the target item only. Individuals assigned to divided-attention conditions also were instructed to perform a digit-monitoring task that was used by Rabinowitz et al. (1982) as well as Park et al. (1986). They were told that they would hear a series of digit pairs presented over a tape recorder and that they should listen to each pair. If both members of the pair were odd, they were to write down the pair; otherwise, they were to do nothing. The participants gained some experience with the digit-monitoring task, and then the acquisition phase of the experiment began.

During acquisition, the 64 target items were presented via a Kodak Carousel projector at a 5 sec rate. Half of the items were presented with a cue and half without. Every item was presented both with and without a cue, counterbalanced across subjects. Following acquisition, a 3-min filler task was presented, and then recognition began. During recognition, participants were instructed to evaluate each target and determine whether they had studied it during acquisition. They were told that they were to base their decision solely on the target and that the contextual cue could have been added to or deleted from acquisition. Participants evaluated a total of 96 items, 64 acquisition items and 32 distractors. Each recognition item was presented for 8 sec and participants circled "yes" or "no" on their data sheet to indicate their memory of the item.

RESULTS

Hit rates, false alarm rates, and d' scores (summarized in Table I) were calculated for each participant and then were subjected to analysis of variance (ANOVA). The d' score, a composite measure of memory performance, is calculated from both hit and false alarm rates. Only the d' analysis will be reported here, as it is the most sensitive measure of performance.

The d' scores were calculated as follows. The cued false alarms scores were used with hit rates to calculate d's for the two conditions when participants received cues at retrieval (absent-present and present-present), whereas the uncued false alarm rate was used to calculate d' scores in the remaining two conditions. A split-plot ANOVA included age and attention as between-group variables and encoding and retrieval as within-subject variables. In addition, because the older participants differed significantly from the young participants on the vocabulary measure, the score on this test was included as a covariate. The analysis yielded a significant attention main effect, $F(1, 46) = 22.91$, $p < .005$, $\omega^2 = .23$, due to poorer memory in the divided-attention compared to the control condition (M = 1.57 and 2.76 respectively). There also was a main effect of encoding, $F(1, 47) = 7.15$, $p < .01$, $\omega^2 = .02$, caused by participants performing better when an encoding cue was present compared to when one was not (M = 2.26 and 2.09, respectively). There also was a main effect of retrieval, $F(1, 47) = 13.05$, $\omega^2 = .03$, which occurred due to the facilitating presence of a retrieval cue on recognition (M = 1.95 without a cue; ,M = 2.40 with a cue). Finally, the encoding and retrieval variables interacted, $F(1, 47) = 8.93$, $p < .005$, $\omega^2 = .01$, as performance was best in the present-present condition (2.58) compared to the other three conditions (M = 1.95 for the absent-absent; M = 2.23 for the absent-present; and M = 1.95 for the present-absent). The three-way interaction of age with encoding and retrieval was very small (F = .18) and did not approach significance, indicating that both age groups showed similar responses to the encoding/retrieval manipulations.

Table 1. Hit Rates, False Alarm Rates,[a] and d′ Scores[b] as a Function of Age, Divided-Attention, and Encoding and Retrieval Cues

	Young Attention						Old Attention					
	Control			Divided			Control			Divided		
Encoding/ retrieval condition	Hits	False Alarms	d′	Hits	False Alarms	d′	Hits	False Alarms	d′	Hits	False Alarms	d′
Present-Present	.89	.08	3.18	.68	.09	2.25	.92	.12	3.22	.67	.17	1.60
Present-Absent	.89	.10	2.77	.57	.17	1.38	.83	.17	2.48	.62	.26	1.05
Absent-Present	.83	.08	2.67	.63	.09	2.14	.83	.12	2.68	.59	.17	1.35
Absent-Absent	.84	.10	2.55	.63	.17	1.60	.85	.17	2.52	.58	.26	1.05

[a]False alarm rates are available only for the retrieval manipulation. As a result, each false alarm rate appears twice in each column with the two relevant retrieval conditions.

[b]d′ was calculated from the formula $d' = z(\text{FAs}) - z(\text{Hits})$.

DISCUSSION

The major findings from the present study can be summarized. First, there was no evidence for an age × encoding specificity interaction in older adults. Second, both old and young adults performed worse under conditions of divided attention. There was no evidence that the divided-attention task had a greater effect on the older adults compared to the young adults (which would have been indicated by an age × attention interaction) or that the divided-attention task caused either age group to rely more on the contextual cues for support (indicated by an attention × encoding cue interaction). Finally, there was no evidence for a significant difference in picture recognition between the two groups, even under conditions of divided attention, as the age main effect was not significant and did not interact with other variables.

The failure to find evidence for an age × encoding interaction suggests that the effect described by Rabinowitz et al. (1982) may be limited to verbal materials or to recall paradigms. The finding supports the Park et al. (1984) result for well-integrated pictorial detail and suggests that their findings can be generalized to a broader range of stimuli and stimulus relatedness and integration with cues were not controlling factors.

The finding that memory and encoding processes in older adults do not appear to be qualitatively different from those in young adults under conditions of divided attention is interesting. If, as has been suggested, older adults have more limited processing resources than young adults, then, when some of these resources are devoted to a distractor task, older adults should have less remaining capacity to deal with the memory task than younger adults and should decline more. Since the divided-attention task clearly depressed performance, it is reasonable to assume that it did limit remaining processing resources; nevertheless, both age groups performed equally. Perhaps the divided-attention task did not interfere with the processing aspects of the visual-recognition task, as it was verbal/auditory rather than visual in nature. The dual-coding argument presented by Paivio (1971) suggests that a task providing visual rather than verbal interference might not only be more disruptive, but possibly result in the emergence of an age × attention interaction, which would verify the limited processing resource hypothesis.

The third finding of interest is that memory in the older adults was not quantitatively different from that in the young adults under any condition, in spite of evidence that performance was well below the ceiling for both groups. Because this replicates a finding by Park et al. (1986), who used an entirely different set of stimulus materials under both control and divided-attention conditions, the effect appeared to be reliable. Park et al. (1984) also reported no differences in picture recognition between old and young adults with a third set of stimulus pictures. Our findings suggest that a systematic analysis of the types of situations and tasks in which age effects do and do not occur with visual stimuli is warranted.

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